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WCDMA&LTE
Audio Design Note

UMTS/HSPA/LTE Module Series

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About the Document

History

Revision	Date	Author	Description
1.0	2016-12-02	Yeoman CHEN/ Jun WU	Initial
1.1	2017-01-06	Jun WU	1. Added some descriptions, notes and an example to explain the differences in audio setting and audio AT commands between EC2x and UCxx modules (Chapter 5 and Chapter 6) 2. Modified the descriptions of AT commands AT+QAUDCFG="digital/dlgain" and AT+QAUDCFG="innercodec/dlgain" (Chapter 6.10 and Chapter 6.11)

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1 Introduction

The document is intended for engineers and customers who are using the audio interface (PCM interface) of Quectel modules. It introduces how to design and use the PCM interface in details in the following chapters.

This document is applicable to Quectel UCxx and EC2x modules. In this document, UCxx includes UC15 and UC20, and EC2x includes EC20, EC21, EC25 and EC20 R2.0.

For the audio design of Quectel UGxx (UG95 & UG96) modules, please refer to *document [4]*.

2 PCM Characteristics

The PCM interfaces of Quectel UCxx and EC2x modules support the following working modes:

- Primary mode (short frame synchronization)
- Auxiliary mode (long frame synchronization)

These modules support 8-bit a-law and μ-law, and also 16-bit linear data formats. They can work as either the master or the slave in primary mode, and only the master in auxiliary mode.

The following tables show the pin definition and electrical characteristics of PCM interface.

Table 1: Pin Definition

Pin Name	I/O	Description
PCM_IN	DI	PCM data input
PCM_OUT	DO	PCM data output
PCM_SYNC	IO	PCM data frame sync signal, output as master and input as slave
PCM_CLK	IO	PCM data bit clock, output as master and input as slave
I2C_SCL	OD	I2C serial clock
I2C_SDA	OD	I2C serial data

Table 2: I/O Characteristics

Parameter	Description	Min	Max	Unit
V_{IL}	Low-level input voltage.	-0.3	0.35*VDD_EXT	V
V_{IH}	High-level input voltage.	0.65*VDD_EXT	VDD_EXT+0.3	V
V_{OL}	Low-level output voltage.	0	0.45	V
V_{OH}	High-level output voltage.	VDD_EXT-0.45	VDD_EXT	V

VDD_EXT is the power source for modules' GPIO group.

In primary mode, the data is sampled on the falling edge of the PCM_CLK and transmitted on the rising edge. The PCM_SYNC falling edge represents the MSB. In this mode, PCM_CLK supports 128, 256, 512, 1024 and 2048KHz for different speech codecs, but UC15 supports 2048KHz only in primary mode.

The figure below shows the timing relationship of PCM interface with 8KHz PCM_SYNC and 2048KHz PCM_CLK in primary mode.
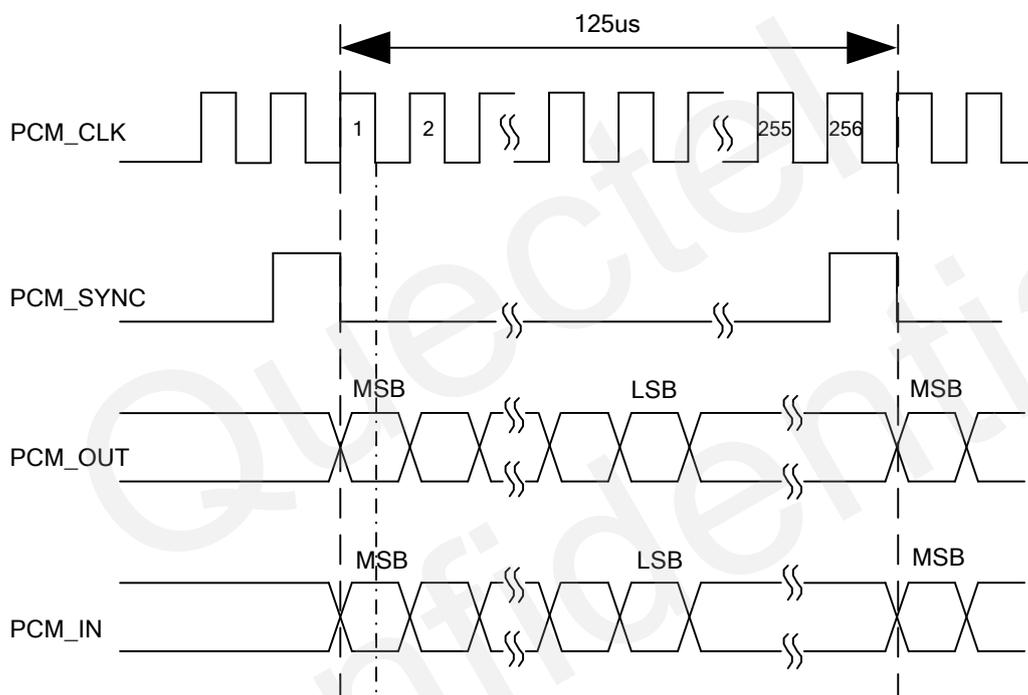
Figure 1: PCM Interface Timing in Primary Mode

In auxiliary mode, the data is also sampled on the falling edge of PCM_CLK and transmitted on the rising edge. But the PCM_SYNC rising edge represents the MSB. In this mode, the PCM interface only acts as the master with a 128KHz PCM_CLK and an 8KHz, 50% duty cycle PCM_SYNC.

The following figure shows the timing relationship of PCM interface in auxiliary mode.
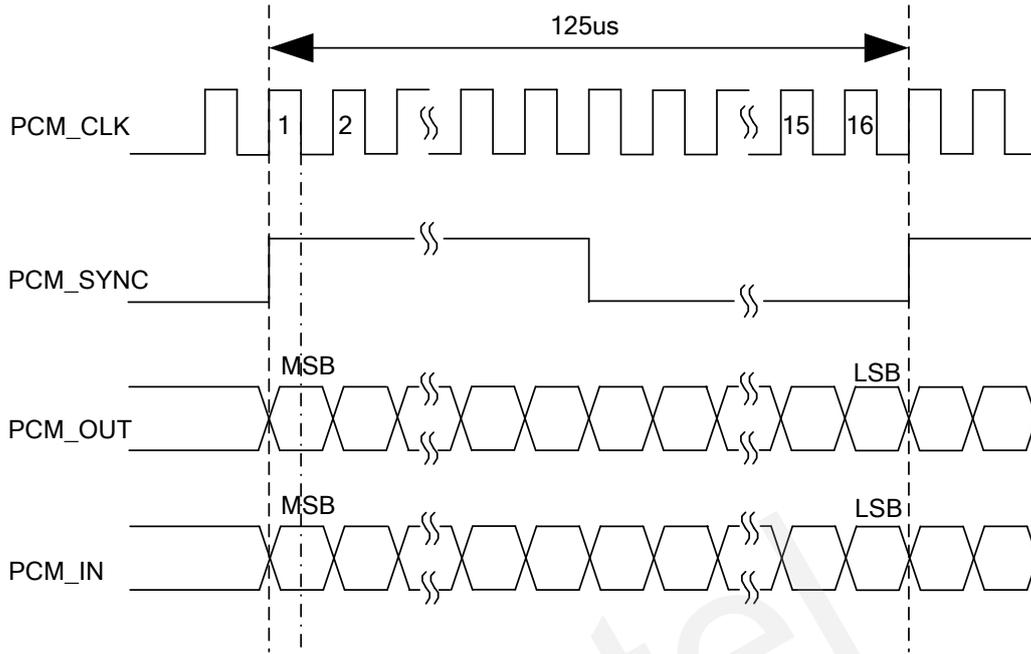
Figure 2: PCM Interface Timing in Auxiliary Mode

Both the clock and mode can be configured by AT commands, and the default configuration is the master mode using short frame synchronization format with 2048KHz PCM_CLK and 8KHz PCM_SYNC. Additionally, the module firmware has integrated the configuration on some popular audio codecs (such as NAU8814, ALC5616, etc.) which can be realized through the I2C interface. For more details, please refer to *document [3]* for the command **AT+QDAI**.

For peripherals, the module works in PCM master mode, and the following figure illustrates the connection among the peripheral, module, and the codec.
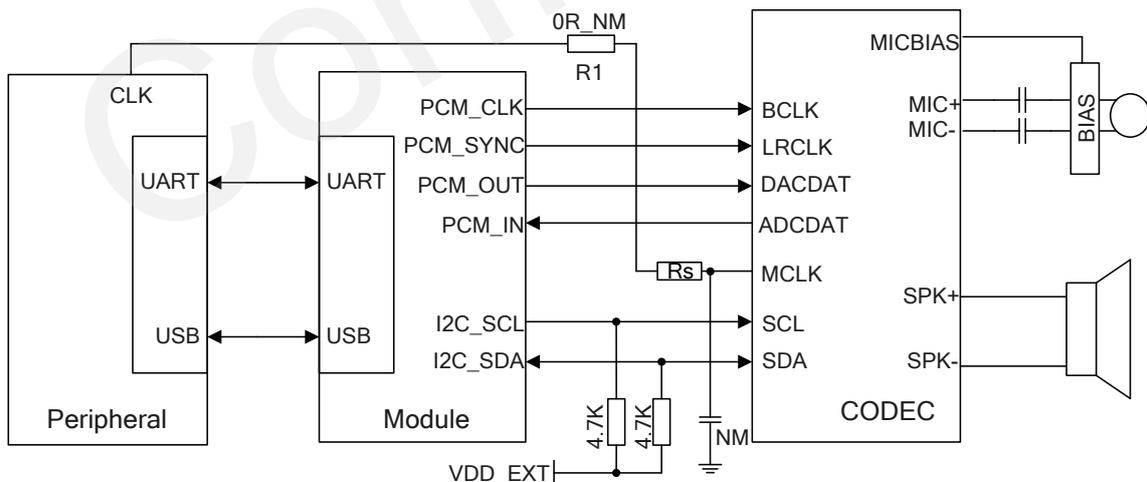
Figure 3: Peripheral, Module and Codec Connection Diagram

NOTES

1. The communication between module and peripheral can be realized through the UART or USB interface.
2. The MCLK of codec can be powered by the peripheral or an external XTAL, if it is needed in the audio codec.
3. It is recommended to reserve an RC (R=22Ω, C=22pF) circuit on the PCM lines, especially for PCM_CLK.
4. EC20's 8-bit a-law and μ-law are still under development.

3 Audio Circuit Design

Audio codecs NAU8814, ALC5616, MAX9860 and TLV320AIC3104 have been approved for PCM application. The following sub-chapters will show some audio circuit designs with these codecs.

3.1. PCM Design with NAU8814

The following figure shows the PCM application with NAU8814 from *Nuvoton* (http://www.nuvoton.com), and an I2C interface is available in the design for codec configuration.
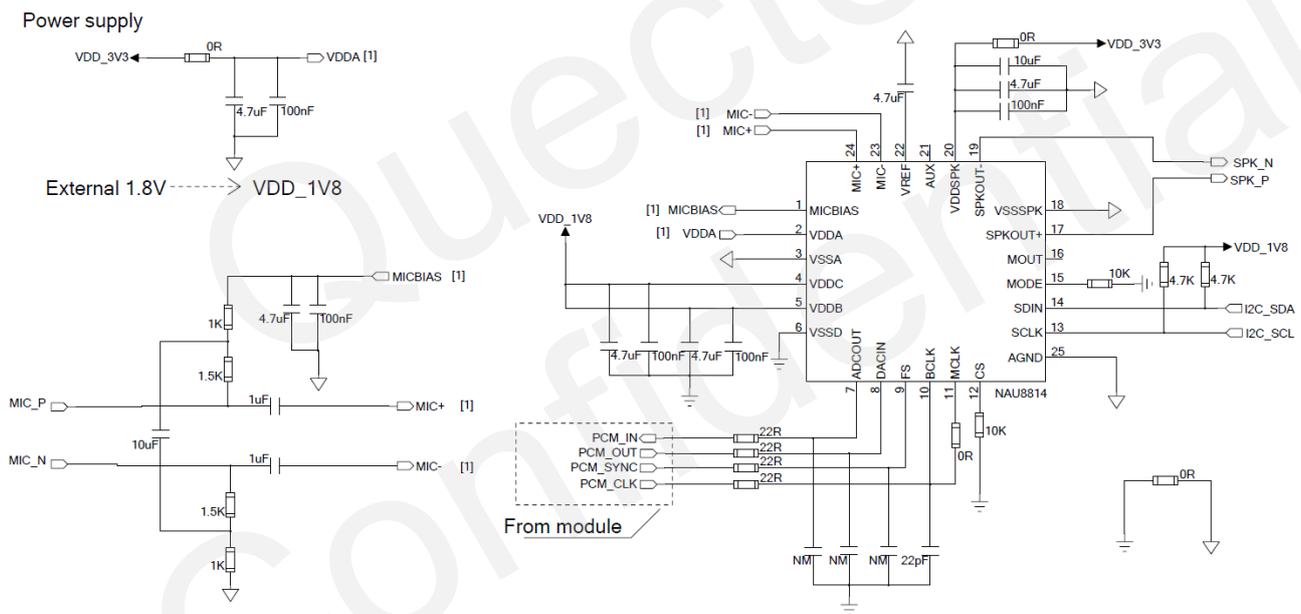
Figure 4: PCM Application with NAU8814

NOTES

1. The RC filter circuit (R=22 ohm, C=22pF) needs to be installed on PCM_CLK line.
2. VDD_3V3 needs to be powered externally.
3. Set **AT+QDAI=2** to choose NAU8814. For more details please refer to *document [3]*.

3.2. PCM Design with ALC5616

The following figure shows the PCM application with ALC5616 from *Realtek* (http://www.realtek.com.tw), and an I2C interface is available in the design for codec configuration.
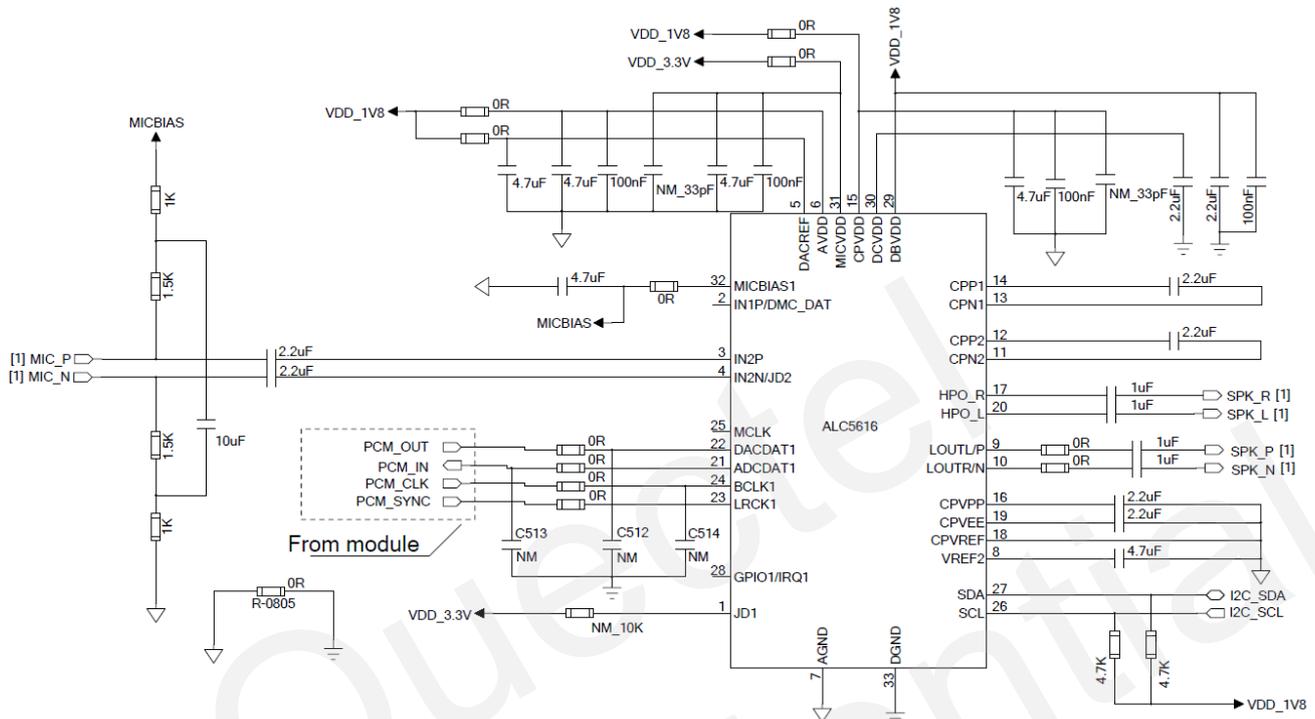
Figure 5: PCM Application with ALC5616

NOTES

1. VDD_3V3 and VDD_1V8 need to be powered externally. Please pay attention to the power-on sequence of ALC5616. For more details, please refer to its datasheet.
2. The RC filter circuit (R=22 ohm, C=22pF) should be installed on PCM_CLK line.
3. Set **AT+QDAI=3** to choose ALC5616. For more details please refer to *document [3]*.

3.3. PCM Design with MAX9860

The following figure shows the PCM application with MAX9860 from *Maxim* (http://www.maxim-ic.com), and an I2C interface is available in the design for codec configuration.
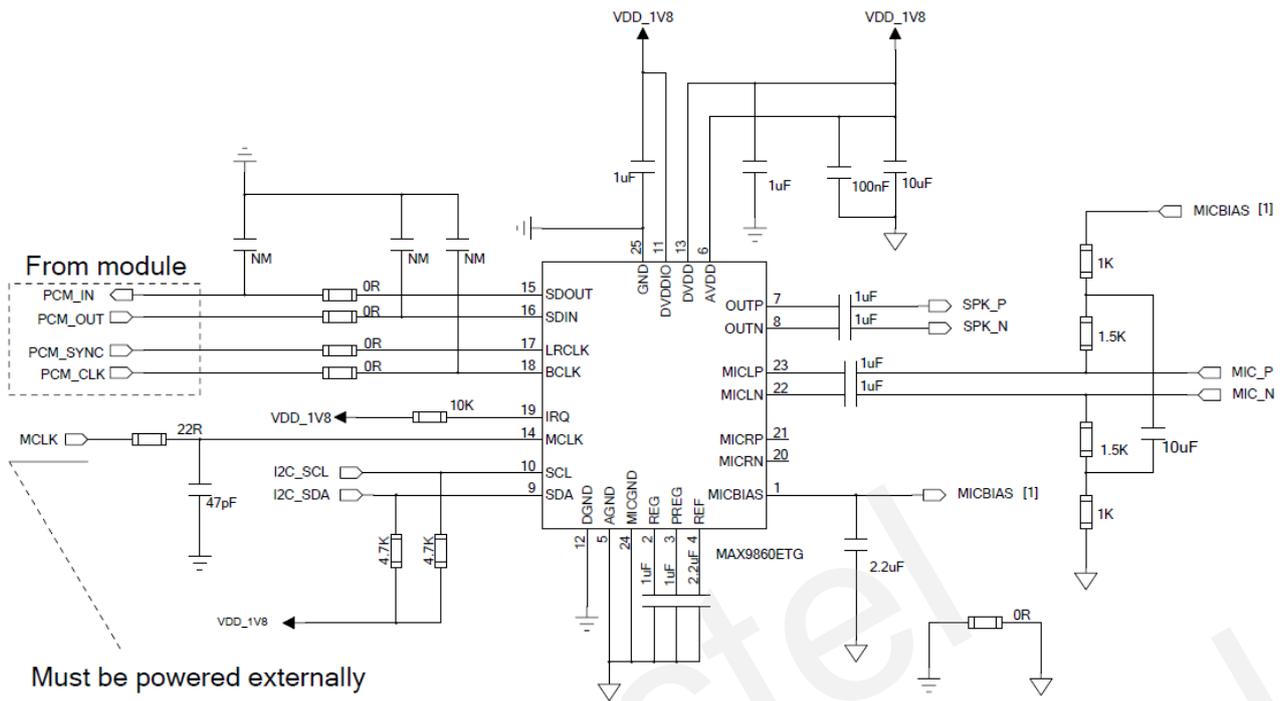
Figure 6: PCM Application with MAX9860

NOTES

1. The RC filter circuit (R=22 ohm, C=22pF) should be installed on PCM_CLK line.
2. Set **AT+QDAI=4** to choose MAX9860. For more details please refer to *document [3]*. The firmware of EC2x modules has not integrated the configuration on MAX9860 by now.
3. MCLK should be powered externally.

3.4. PCM Design with TLV320AIC3104

The following figure shows the PCM application with TLV320AIC3104 from *Texas Instrument* (http://www.ti.com.cn), and an I2C interface is available in the design for codec configuration.
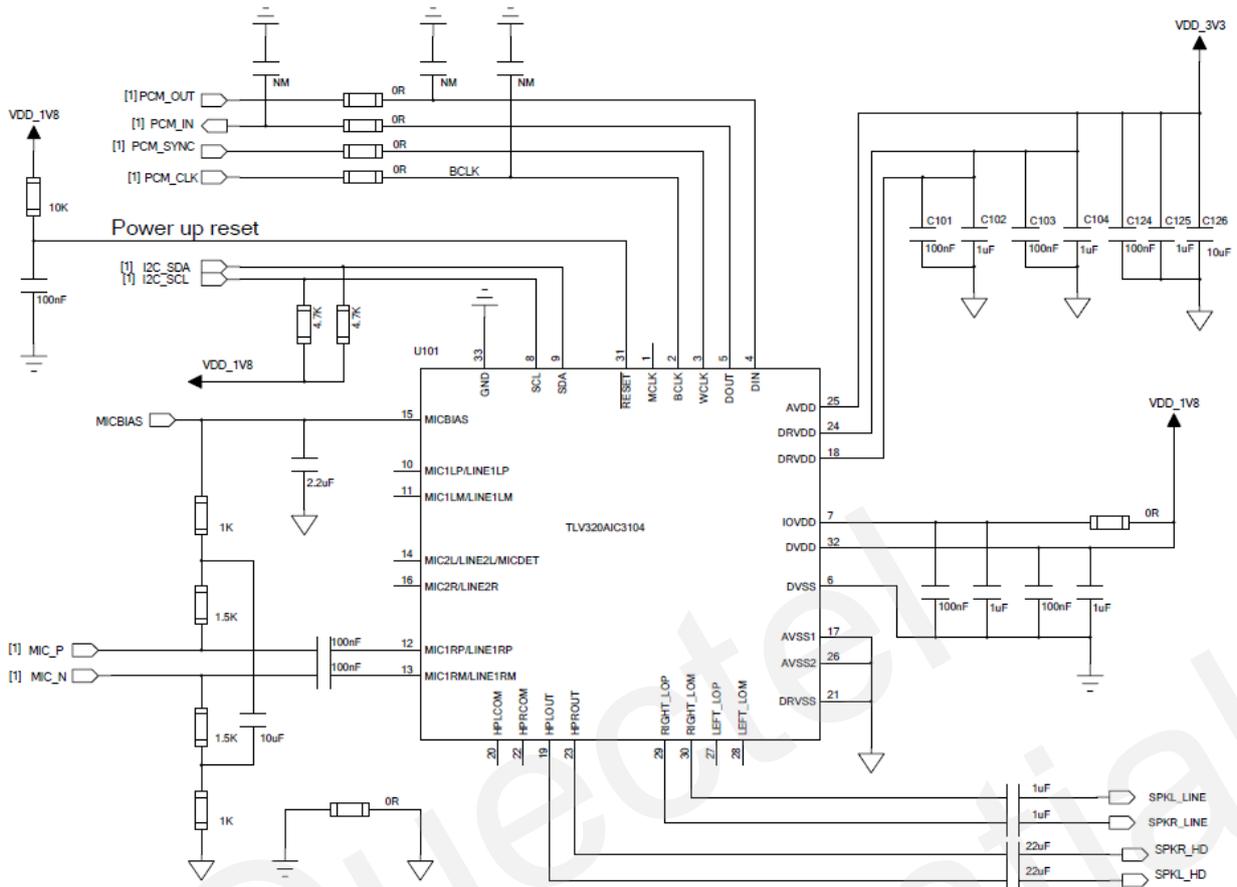
Figure 7: PCM Application with TLV320AIC3104

NOTES

1. The RC filter circuit (R=22ohm, C=22pF) should be installed on PCM_CLK line.
2. VDD_3V3 and VDD_1V8 need to be powered externally. Please pay attention to the power-on sequence of TLV320AIC3104. For more details, please refer to its datasheet.
3. Set **AT+QDAI=5** to choose TLV320AIC3104. For more details please refer to *document [3]*.

3.5. PCM Design with MCU

UCxx and EC2x modules can work in either PCM master mode or slave mode to communicate with MCU.

- Primary mode (short frame synchronization, works as both master and slave)
- Auxiliary mode (long frame synchronization, works as master only)

They provide a 1.8V PCM interface, but 2.6V PCM interface for UC15. A level translator should be used if customers' application is equipped with a 3.3V UART interface. The level translator TXS0104 provided by *Texas Instrument* is recommended.

3.5.1. Module Works in PCM Master Mode

In PCM master mode, UCxx and EC2x modules support both short and long frame synchronization. The data is sampled on the falling edge of the PCM_CLK and transmitted on the rising edge. The PCM_SYNC falling edge represents the MSB. PCM_CLK supports 128, 256, 512, 1024 and 2048KHz, and PCM_SYNC supports 8KHz.
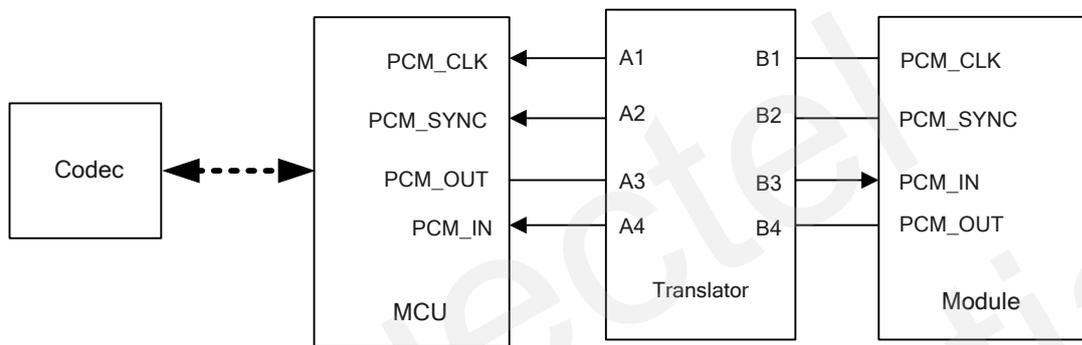
Figure 8: Reference Design When Module Works in PCM Master Mode

The modules support 8-bit a-law and µ-law, and also 16-bit linear data formats. The PCM interface can be configured via **AT+QDAI** command, and an example is shown below.

Example

AT+QDAI=1,0,0,4,0 . **OK**	//PCM master mode, short frame synchronization, PCM_CLK=2.048MHz, 16bit data

3.5.2. Module Works in PCM Slave Mode

When the module works in PCM slave mode, the data is sampled on the falling edge of the PCM_CLK and transmitted on the rising edge. The PCM_SYNC falling edge represents the MSB. PCM_CLK supports 128, 256, 512, 1024 and 2048KHz, and PCM_SYNC supports 8KHz.
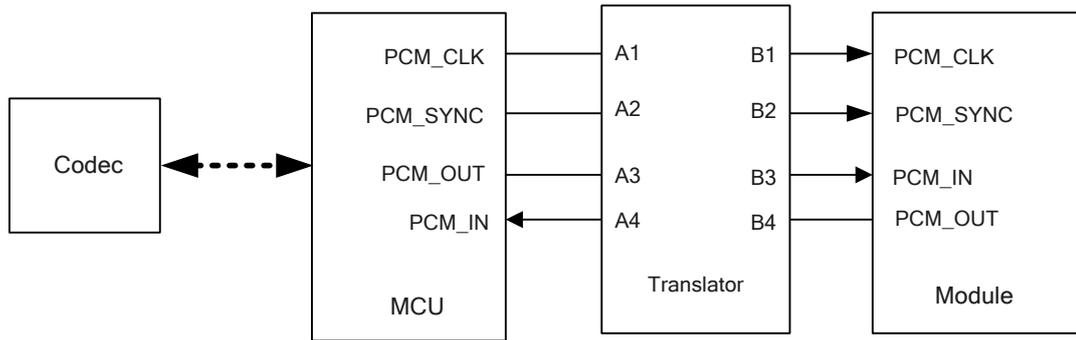
Figure 9: Reference Design When Module Works in PCM Slave Mode

The modules support 16-bit linear data formats in PCM slave mode. The PCM interface can be configured via **AT+QDAI** command, and an example is shown below.

Example

AT+QDAI=1,1,0,4,0	//PCM slave mode, short frame synchronization, PCM_CLK=2.048MHz, 16bit data.
OK	

NOTES

1. It is recommended to reserve an RC (R=22 ohm, C=22pF) circuit on the PCM lines, especially for PCM_CLK.
2. UC15 and EC20 do not support PCM slave mode presently.

3.6. Microphone Interface Design
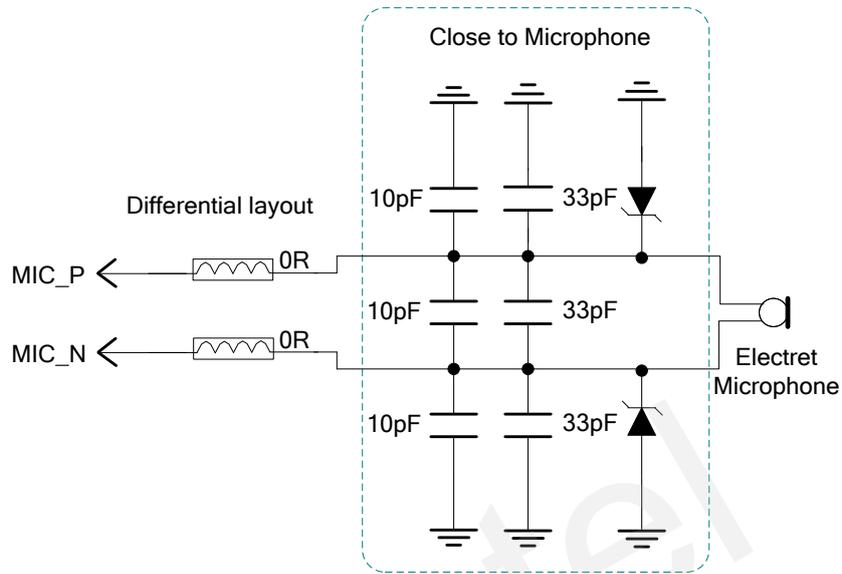
Figure 10: Microphone Interface Design

3.7. Receiver Interface Design
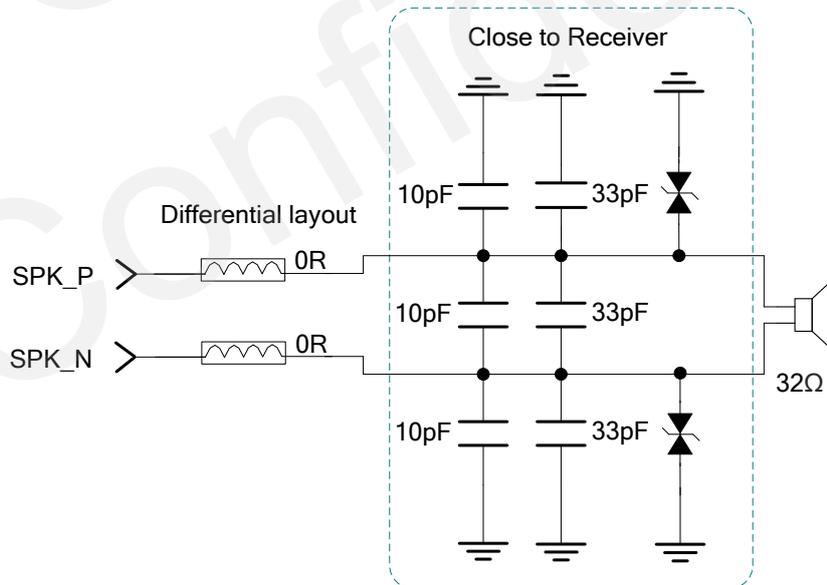
Figure 11: Receiver Interface Design

3.8. Earphone Interface Design

The following figure shows the single-ended application for earphone interface design.
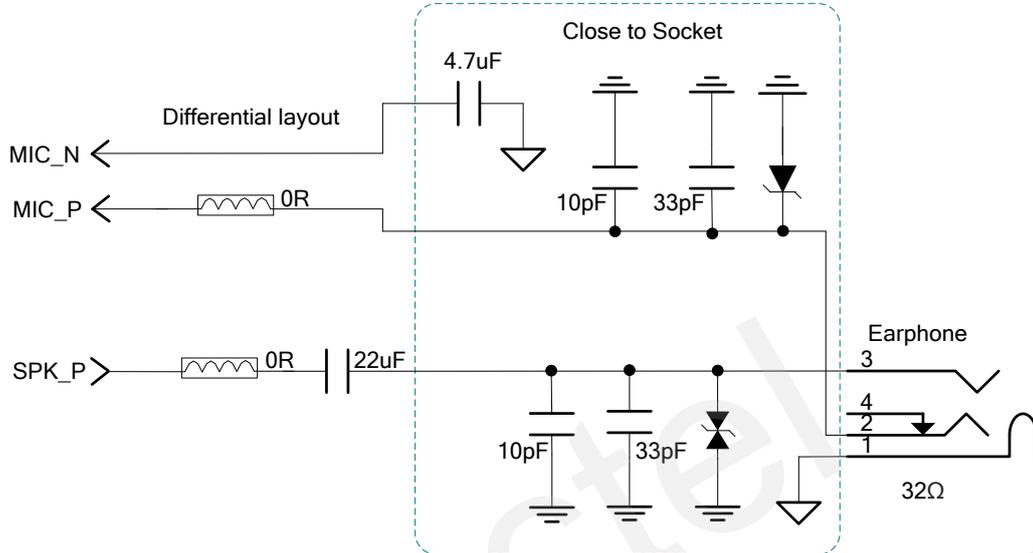
Figure 12: Earphone Interface Design

3.9. Speaker Interface Design

If an 8Ω speaker is applied, it is recommended to add an audio amplifier.
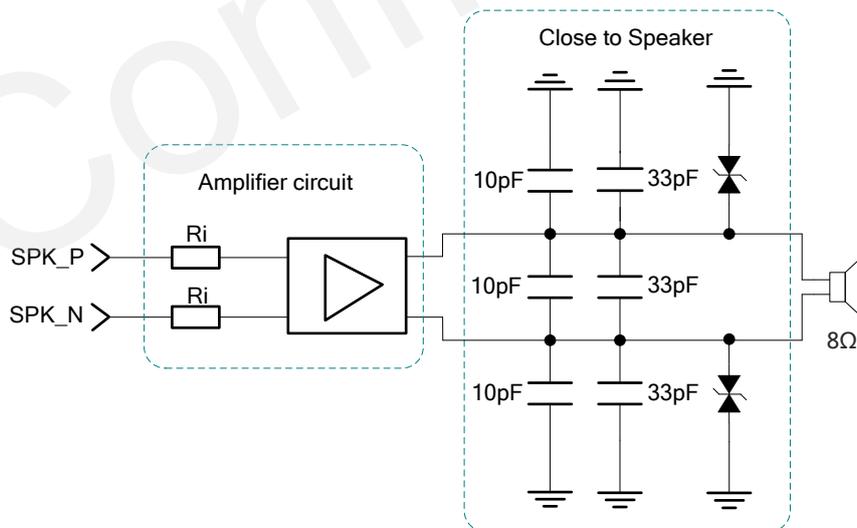
Figure 13: Speaker Interface Design (with Amplifier Circuit)

4 Design Considerations

4.1. Power Supply for PCM Codecs

Different PCM codecs have different supply voltages. Hence, it is recommended to power a PCM codec with a dedicated LDO, and do not share this power supply with other circuits.

4.2. Suggestions for Audio Circuit Layout

Power supply ripple, unbalanced ground and RF burst have negative effects to audio circuit layout. In order to avoid them, the layout of MICP_PCM/MICN_PCM and SPKP_PCM/SPKN_PCM must meet the rule of differential signal. Moreover, these two pairs of signals should be separated from each other through ground shielding on not only upper and lower layers but also right and left sides, to avoid echo from SPK signal to MIC signal. The following figure shows an example.
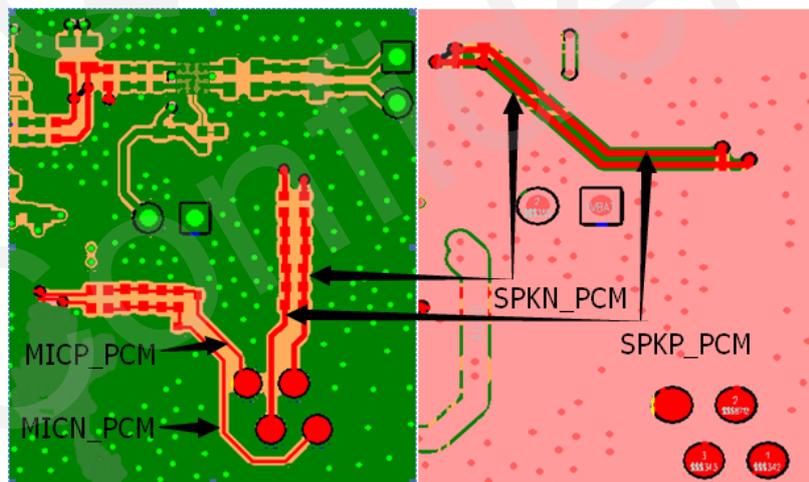
Figure 14: Audio Channel Layout Example

4.3. TDD Noise Solution

It is important to avoid or reduce TDD noise in audio circuit design and layout. This sub-chapter provides some suggestions for TDD noise reduction or elimination.

1. Different capacitors have their own self-resonant frequencies due to different fabrication processes and materials. Generally, a 33pF capacitor (0603 package) is recommended to be used for filtering GSM900 interference and 10pF capacitor (0603 package) for filtering DCS1800 interference on the power and analog audio signal lines. It is strongly recommended to add the two capacitors (10pF and 33pF) near the electret-microphone in handset and hands-free applications. These two capacitors could largely suppress coupling TDD noise from RF interference.

2. The capacitors should be placed close to audio components or audio interface, and the layout must be short.

3. Ground shielding area should be as large as possible to reduce the ground impedance and improve grounding performance.

4. Reduce power supply voltage ripple, especially the power supply in audio circuits. This can be achieved through using a wide wire for the layout between power source (like adapter interface, battery connector, or LDO output pin) and audio power supply. Good antenna matching is also important for reducing power ripple.

5. The filtering capacitors and ESD protection devices should be connected to the main digital ground. Separate the analog ground from the digital ground while routing, and then connect them at a single point on the PCB with a 0 ohm resistor, so as to reduce digital interference and background noise.

6. The antenna must be stay away from audio components and the layout of audio circuit. Keep a distance of at least 5cm between the antenna and the microphone.

7. The layout of power supply must be stay away from the audio components and layout, and cannot be parallel.

4.4. Suggestions for Mechanical Design

It is important to consider how to suppress echo in the equipment with hands-free function or in an application where the microphone and the speaker are very close to each other.

The mechanical structure design has significant impact on echo issue. If it is not properly designed, the echo suppressing arithmetic in software will not be able to make up the echo issue caused by bad mechanical structure, and even force to redesign.

The echo issue could be generated from several paths as shown in the figure below.
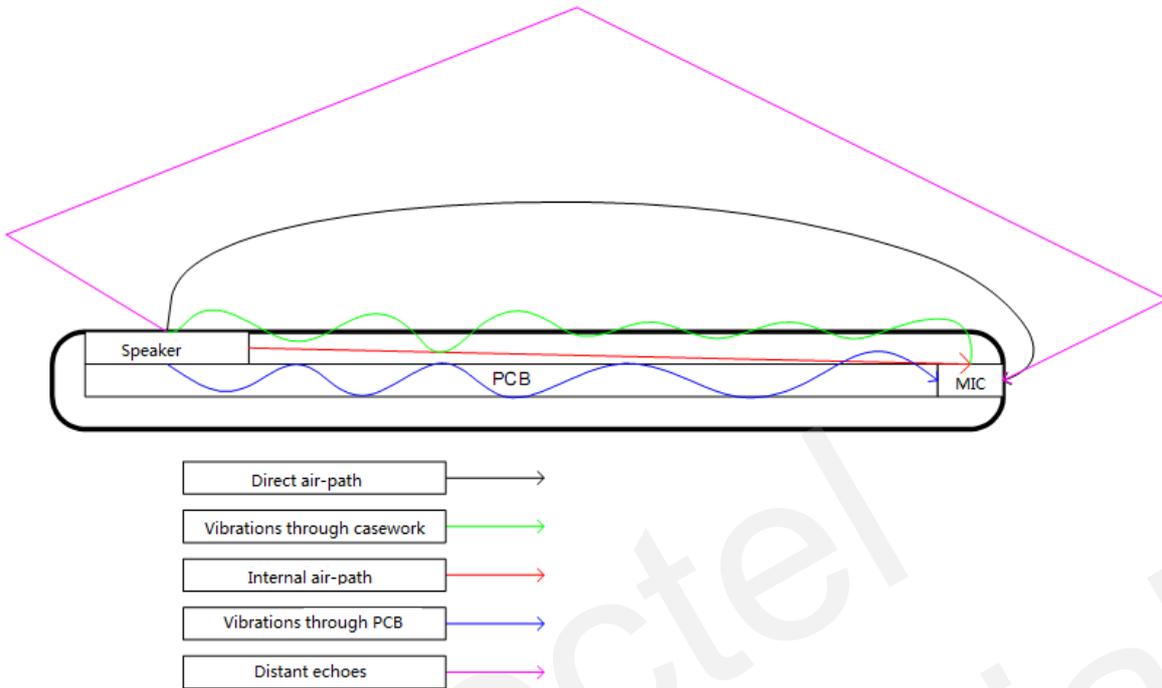
Figure 15: Five Echo Paths

In these five paths, the internal air-path and direct air-path are the primary influential factors. Other three factors (vibrations through casework, vibrations through PCB, distant echoes) are the secondary ones.

How to deal with the echo generated from internal air-path?

Separating microphone from internal space of chassis by foam or rubber ring can effectively suppress the inner echo interference. The figure below shows a recommended design for microphone socket.
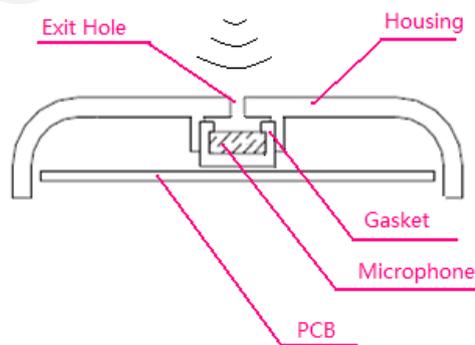
Figure 16: Recommended Microphone Socket Design

> **NOTE**
>
> The best installation way of microphone socket is to encase microphone by silicone cover except for the front cavity, and design a cylindrical hole whose center is the exit hole of the chassis. Also, make sure the microphone with silicone cover just fit the cylindrical hole, so as to only let voice enter into microphone from the exit hole rather than the leak of chassis interior. Certain air space room should be reserved in the front cavity of microphone as it is necessary for good microphone performance.

The following figure shows a recommended design for speaker socket.
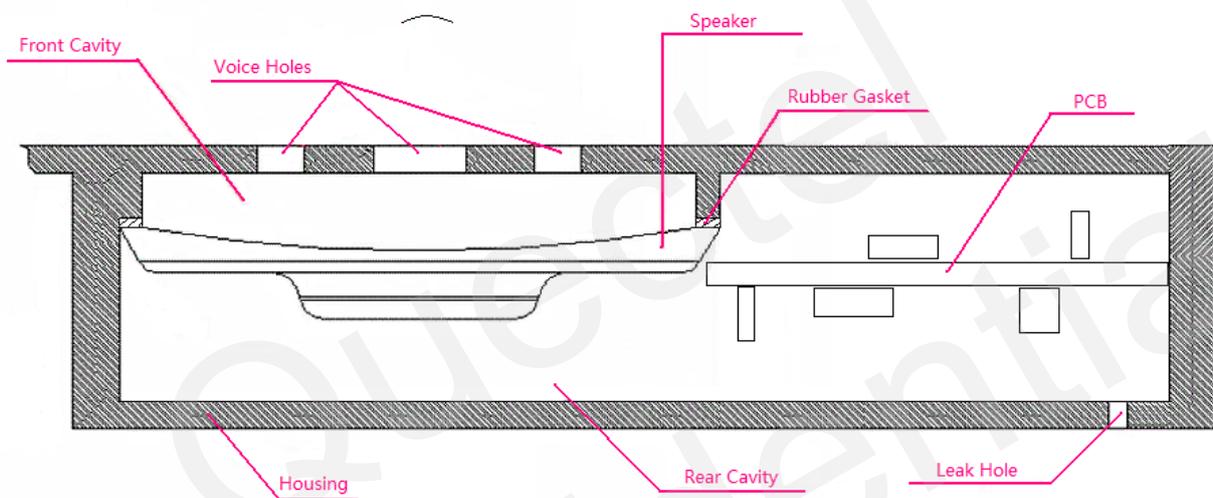
Figure 17: Speaker Socket Design

A good way to suppress the internal echo path is to seal the rear cavity of receiver, which is usually expensive. The rear cavity of receiver and speaker is important for good voice quality. A sealed rear cavity with sufficient space could produce a good voice output. An 8Ω speaker is often big and thus it is difficult to give an independently sealed rear cavity for it. However, sealing microphone socket in chassis is always useful for internal echo suppressing. The microphone socket and speaker socket should be designed as far as possible. If there is any unavoidable leak hole, keep it far away from the microphone. If the leak hole is close to the microphone, the voice coming from the hole could be picked up by microphone, and then leads to echo at the far end. If the leak hole is close to the speaker, the output voice quality could be aggravated at a certain extent.

4.5. Components of Speaker

Speakers and receivers with higher sensitivity, flatter frequency response, less THD and impedance of 32Ω (receiver), 16Ω (receiver) or 8Ω (speaker) are recommended. These technical data are often shown in the datasheet of the speaker and receiver. For a speaker, its frequency response and THD performance can be tested by a speaker test system. The speaker frequency response and THD are shown in the following two figures.
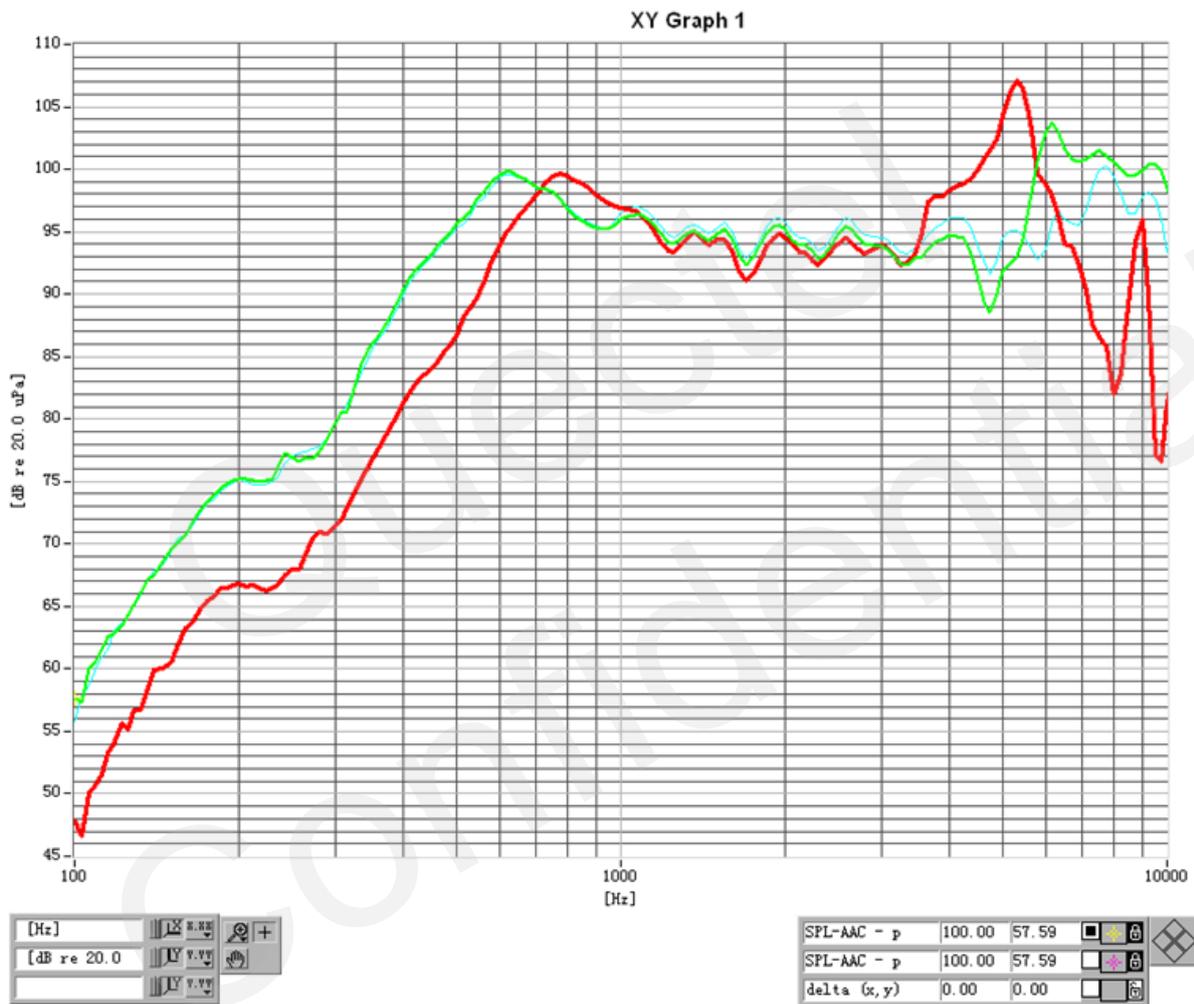
Figure 18: Speaker Frequency Response

NOTE

- Horizontal axis: frequency
- Longitudinal axis: loudness (dB)
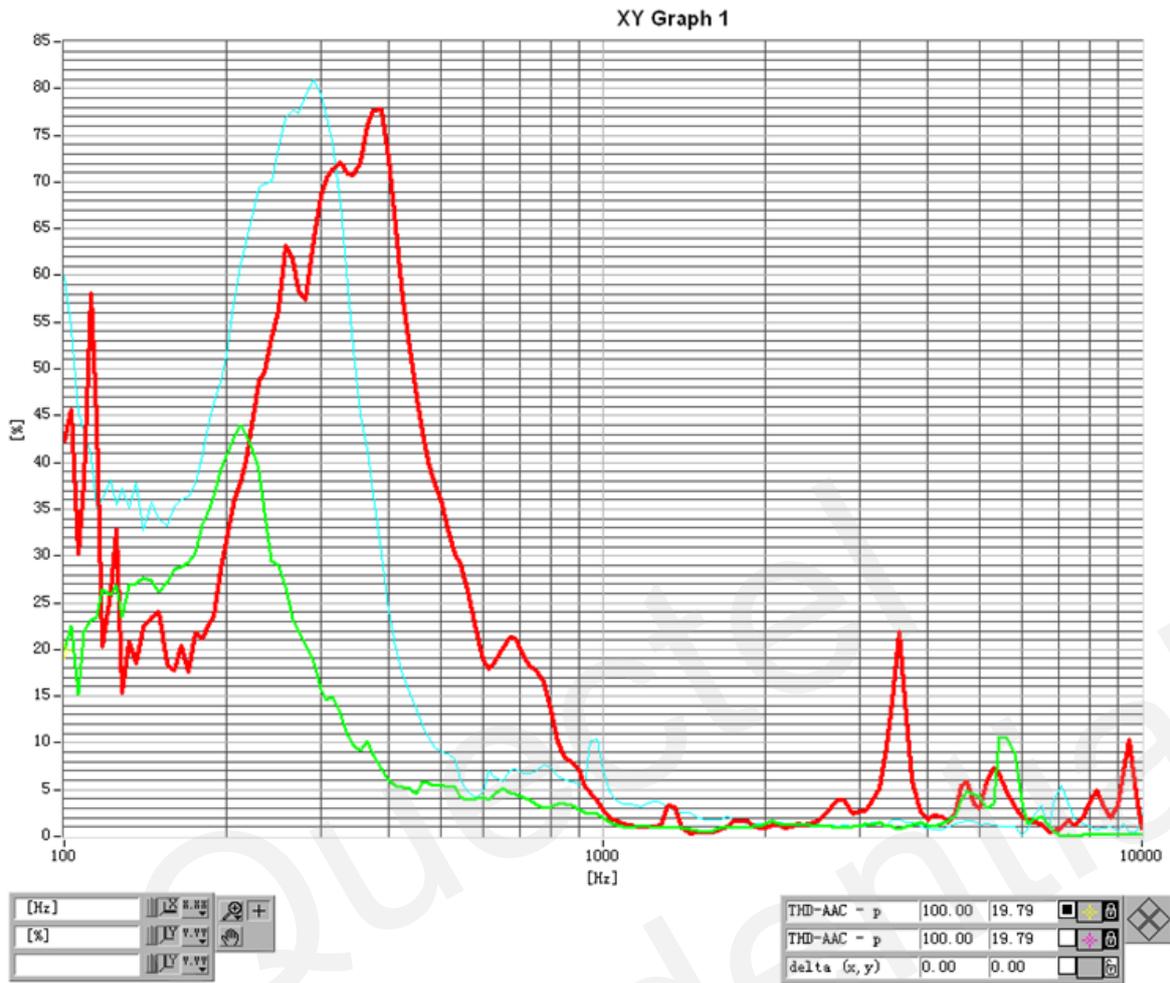
Figure 19: Speaker THD

> **NOTES**
>
> 1. Horizontal axis: frequency
>   Longitudinal axis: distortion (%)
> 2. In the above two figures, the three colors represent products of three different vendors. Through comprehensive comparison, the green one performs the best, the blue one is the second, and the red one is the worst.

4.6. Components of Microphone

It is recommended to use an electret microphone with a sensitivity of -42±3dB/Pa @2V (not less than -44±3dB) and impedance of 2.2Kohm. If RF TDD noise is detected at the microphone, please contact the

microphone vendor for products with better RF suppression capability. Furthermore, the microphone channel circuit can be optimized to decrease TDD noise at microphone side.

5 Audio Modes

There are three kinds of common audio modes: handset, headset and handsfree. **AT+QAUDMOD** is used to choose audio modes. For each mode, there are some default settings, such as **AT+CLVL**, **AT+QSIDET**, and **AT+QMIC**.

If the audio performance is not good and **AT+QAUDMOD** command has been set, the following steps can be applied to tune the audio settings:

Step 1: Set **AT+CLVL** to tune downlink volume.
Step 2: Set **AT+QMIC** to tune uplink volume.
Step 3: If the downlink volume is a little low or high, and **AT+CLVL** has been set, please use **AT+QRXGAIN** (EC2x modules)/**AT+QAUDCFG="digital/dlgain"** (UCxx modules) to tune it. For uplink volume, **AT+QMIC** can be used.
Step 4: If the recommended codec is used, customers can use **AT+QAUDCFG** to tune the volume of recommended codec.
Step 5: Set **AT+QSIDET** to tune side tone.
Step 6: If there is echo or noise left, please use **AT+QEEC** to tune EEC.

NOTES

1. Please do not set the volume too high, otherwise it will influence EEC and NR.
2. **AT+QAUDMOD** must be set before using other commands.

The following sub-chapters provide some examples which show how to tune the audio settings in different audio modes.

5.1. Speech Call in Handset Mode

The default mode is handset mode.

AT+QAUDMOD=0	//**<mode>**=0 means handset mode is selected.
OK	
AT+CLVL=3	//Tuning downlink volume
OK	

AT+QMIC= 25905,14567   //Tuning uplink volume

OK
AT+QSIDET=1298   //Tuning side tone

OK

5.2. Speech Call in Headset Mode

Set **AT+QAUDMOD=1** to select headset mode.

AT+QAUDMOD=1   //**\<mode\>**=1 means headset mode is selected.

OK
AT+CLVL=2   //Tuning downlink volume

OK
AT+QMIC=25905,14567   //Tuning uplink volume

OK
AT+QSIDET=0   //Tuning side tone

OK

5.3. Speech Call in Handsfree Mode

Set **AT+QAUDMOD=2** to select handsfree mode. This mode is always used for vehicle-mounted devices.

AT+QAUDMOD=2   //**\<mode\>**=2 means handsfree mode is selected.

OK
AT+CLVL=4   //Tuning downlink volume

OK
AT+QMIC=25905,14567   //Tuning uplink volume

OK
AT+QSIDET=0   //Tuning side tone

OK

6 Audio AT Commands

This chapter will introduce the common audio AT commands. For more other AT commands details, refer to **document [3]**.

6.1. AT+QDAI   Digital Audio Interface Configuration

The command is used to configure the digital audio interface. When **<io>**=1, customers can define the PCM mode (master/slave mode) by themselves. When **<io>**=2 and the external codec chip linked with PCM interface is the NAU8814 model which is configurable through the I2C, the module can be used directly and set by the default configurations. When **<io>**=3 and the external codec chip linked with PCM interface is the ALC5616 model which is configurable through the I2C, the module can also be used directly and set by the default configurations.

AT+QDAI Digital Audio Interface Configuration	
Test Command **AT+QDAI=?**	Response **+QDAI: (1-3),(0,1),(0,1),(0-5),(0-2)** **OK**
Read Command **AT+QDAI?**	Response **+QDAI: <io>[,<mode>,<fsync>,<clock>,<format>]** **OK**
Write Command **AT+QDAI=<io>[,<mode>,<fsync>,<clock>[,<format>]]**	Response **OK** **ERROR**
Maximum Response Time	300ms

Parameter

<io>	<u>1</u>	Digital PCM output (customer-defined)
	2	Analog output (for the default audio codec NAU8814).
	3	Analog output (for the default audio codec ALC5616).
<mode>	<u>0</u>	Master mode

	1	Slave mode
<fsync>	0	Primary mode (short-frame synchronization)
	1	Auxiliary mode (long-frame synchronization)
<clock>	0	128K
	1	256K
	2	512K
	3	1024K
	4	2048K
	5	4096K
<format>	0	16-bit linear
	1	8-bit a-law
	2	8-bit μ-law

NOTES

1. Configuration of **<io>** will be saved to NV immediately by default.
2. The PCM interface supports both master and slave mode under short frame synchronization, and only master mode under long frame synchronization.
3. When short frame synchronization and master mode are selected, PCM_CLK supports 256K~4096K clock frequency. If long frame synchronization and master mode are selected, only 128K clock frequency is supported.
4. If slave mode is selected, then PCM_CLK and PCM_SYNC must be provided for modules.
5. When NAU8814 or ALC5616 is selected, please do not input any other parameters.
6. A-law & μ-law are not supported by EC2x modules.

Example

```
AT+QDAI=?              //Query the range.
+QDAI: (1-3),(0,1),(0,1),(0-5),(0-2)

OK
AT+QDAI?               //Query the current interface configuration.
+QDAI: 1,0,0,4,0

OK
AT+QDAI=1,1,0,4,1      //Set PCM interface to slave short-frame synchronization mode, PCM format 8-bit
                         a-law.
OK
AT+QDAI=2              //Select NAU8814.
OK
AT+QDAI=3              //Select ALC5616.
OK
```

6.2. AT+QIIC   I2C Read and Write

The command is used to configure the codec via I2C interface.

AT+QIIC I2C Read and Write	
Test command **AT+QIIC=?**	Response **+QIIC: (0-1),(0-FF),<0-FF>,<1-2>[,<0-FFFF>]** **OK**
Read command **AT+QIIC?**	Response **+QIIC:** **OK**
Execute command **AT+QIIC**	Response **ERROR**
Write command **AT+QIIC=<rw>,<device>,<addr>,<bytes>[,<value>]**	Response **OK** Response **+QIIC: <value>** **OK**

Parameter

<rw>	0	Write command
	1	Read command
<device>	0-0xFF	Device address
<addr>	0-0xFF	Register address
<bytes>	1-2	Read/write bytes
<value>	0-0xFFFF	Data value

NOTES

1. Only 7bit device address is supported presently.
2. The parameters are hexadecimal, and there are some differences between UCxx and EC2x modules in command format:
   - The device address should be shifted one bit to the left for UCxx modules, and this is not required for EC2x modules;
   - There is a need to add a prefix "0x" to the parameters of EC2x modules.

Example

AT+QIIC=0,0x18,0x00,1,0x00 //This command is used for EC2x modules, and the module writes 1byte data 0x00 to device. The device address is 0x18, and the register address is 0x00.

OK

AT+QIIC=0,30,00,1,00 //This command is used for UCxx modules, and the module writes 1byte data 0x00 to device. The device address is 0x18, and the register address is 0x00.

OK

6.3. AT+CLVL   Loudspeaker Volume Level Selection

The command is used to select the volume level of the internal loudspeaker of Quectel UCxx and EC2x modules.

AT+CLVL Loudspeaker Volume Level Selection	
Test Command **AT+CLVL=?**	Response **+CLVL:** (list of supported **<level>**s) **OK**
Read Command **AT+CLVL?**	Response **+CLVL: <level>** **OK**
Write Command **AT+CLVL=<level>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
Maximum Response Time	300ms
Reference 3GPP TS 27.007	

Parameter

<level>   For UCxx modules:
Integer type, value (0-3-7) with manufacturer specific range (smallest value represents the lowest sound level).
<level>   For EC2x modules:

Integer type, value (0-3-5) with manufacturer specific range (smallest value represents the lowest sound level).

> **NOTE**
>
> The parameter will not be saved.

6.4. AT+QMIC Set Uplink Gains of MIC

The command is used to set the uplink gains of microphone.

AT+QMIC Set Uplink Gains of MIC	
Test Command **AT+QMIC=?**	Response **+QMIC: (1),(0-65535),(0-65535)** **OK**
Read Command **AT+QMIC?**	Response **+QMIC: <txgain1>,<txgain2>,<txdgain>** **OK**
Write Command **AT+QMIC=<txgain1>,<txgain2>[,<txdgain>]**	Response **OK** **ERROR**
Maximum Response Time	300ms

Parameter

<txgain1>　Numeric type, reserved, set to 1. This parameter is invalid for EC2x modules.
<txgain2>　Numeric type, indicates uplink codec gain, range: 0-65535. Default value might be different in different audio modes. This parameter is invalid for UC20 module.
<txdgain>　Numeric type, indicates uplink digital gain, range: 0-65535. Default value might be different in different audio modes.

> **NOTE**
>
> These parameters will not be saved.

6.5. AT+CMUT   Mute Control

The command is used to enable and disable the uplink voice muting during a voice call.

AT+CMUT Mute Control	
Test Command **AT+CMUT=?**	Response **+CMUT:** (list of supported**<n>**s) **OK**
Read Command **AT+CMUT?**	Response **+CMUT:<n>** **OK**
Write Command **AT+CMUT=<n>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
Maximum Response Time	300ms
Reference 3GPP TS 27.007	

Parameter

<n>	0	Mute OFF
	1	Mute ON

NOTES

1. This command is valid only during the call.
2. This parameter will not be saved.

6.6. AT+QAUDMOD   Set Audio Mode

The command is used to set the audio mode required for the connected device.

AT+QAUDMOD Set Audio Mode	
Test Command **AT+QAUDMOD=?**	Response For UC20 & EC2x modules:

	+QAUDMOD: (0-2) For UC15 module: **+QAUDMOD: (0-8)** **OK**
Read command **AT+QAUDMOD?**	Response **+QAUDMOD: <mode>** **OK**
Write Command **AT+QAUDMOD=<mode>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
Maximum Response Time	300ms

Parameter

<mode>	For UC20 & EC2x modules: Numeric type, indicates the current configured audio mode. 0 Echo canceller, noise suppressor, digital gain and calibration parameter for Handset 1 Echo canceller, noise suppressor, digital gain and calibration parameter for Headset 2 Echo canceller, noise suppressor, digital gain and calibration parameter for Speaker
<mode>	For UC15 module: Numeric type, indicates the current configured audio mode. 0 Handset mode. 1 Headset mode. 2 Hands free kit mode. 3 Analog hands free kit mode. 4 Loudspeaker mode. 5 AUX PCM Handset mode. 6 AUX PCM Headset mode. 7 AUX PCM Loudspeaker mode. 8 Bluetooth headset mode.

NOTE

The parameter will not be saved.

6.7. AT+QSIDET   Set the Side Tone Gain in Current Mode

The command is used to set the side tone gain value of the current mode.

AT+QSIDET Set the Side Tone Gain in Current Mode	
Test Command **AT+QSIDET=?**	Response **+QSIDET: (0-65535)** **OK**
Read Command **AT+QSIDET?**	Response **+QSIDET: <stgain>** **OK**
Write Command **AT+QSIDET=<stgain>**	Response **OK** **ERROR**
Maximum Response Time	300ms

Parameter

<stgain>	Numeric type, indicates the configured side tone gain in current mode. Range: 0-65535. Default value might be different in different audio modes.

NOTE

The parameter will not be saved.

6.8. AT+QAUDLOOP   Enable Audio Loop Test

The command is used to enable audio loop test.

AT+QAUDLOOP Enable Audio Loop Test	
Test Command **AT+QAUDLOOP=?**	Response **+QAUDLOOP: (0,1),(0-2)** **OK**

Read Command **AT+QAUDLOOP?**	Response **+QAUDLOOP: <enable>,<path>** **OK**
Write Command **AT+QAUDLOOP=<enable>[,<path>]**	Response **OK** **ERROR**
Maximum Response Time	300ms

Parameter

<enable>	Numeric type, to enable or disable audio loop test.	
	0	Disable audio loop test
	1	Enable audio loop test
<path>	Numeric type, indicates the test path. This parameter is intended for UC15 module only.	
	0	MIC1 & SPEAKER1
	1	MIC2 & SPEAKER2
	2	AUX PCM

NOTE

These parameters will not be saved.

6.9. AT+QAUDPATH   Set Audio Output Path

The command is used to set the current audio output path which can be MIC&SPEAKER or AUX PCM.

AT+QAUDPATH Set Audio Output Path	
Test Command **AT+QAUDPATH=?**	Response **+QAUDPATH: (0-2)** **OK**
Read Command **AT+QAUDPATH?**	Response **+QAUDPATH: <path>** **OK**

Write Command	Response
AT+QAUDPATH=<path>	**OK**
	ERROR

Maximum Response Time	300ms

Parameter

<path>	Numeric type, indicates the configured output path.
	<u>0</u> MIC1&SPEAKER1
	1 MIC2&SPEAKER2
	2 AUX PCM

NOTES

1. The parameter will not be saved.
2. This command is intended for UCxx modules only.

6.10. AT+QAUDCFG="digital/dlgain"   Set Downlink Digital Gain

The command is used to set downlink digital gain level.

AT+QAUDCFG="digital/dlgain" Set Downlink Digital Gain	
Test Command **AT+QAUDCFG=?**	Response **······** **+QAUDCFG: "digital/dlgain",<gain>** **······** **OK**
Write Command **AT+QAUDCFG="digital/dlgain"[,<gain>]**	Response If configuration parameters are omitted (**+QAUDCFG="digital/dlgain"**), return the current configuration: **+QAUDCFG: "digital/dlgain",<gain>** **OK** If configuration parameters are entered: **OK** **ERROR** If error is related to ME functionality:

	+CME ERROR: <err>

Parameter

<gain>	Numeric type, indicates the downlink digital gain level. Range: 0-10000. Default value might be different in different audio modes

> **NOTES**
>
> 1. The parameter will not be saved.
> 2. This command is intended for UCxx modules only.

Example

AT+QAUDCFG="digital/dlgain",8000   //Set downlink digital gain to 8000.

OK

6.11. AT+QAUDCFG="innercodec/dlgain"　Set Downlink Digital Gain for Internal Codec

The command is used to set the downlink digital gain level for internal codec.

AT+QAUDCFG="innercodec/dlgain"　Set Downlink Digital Gain for Internal Codec	
Test Command **AT+QAUDCFG=?**	Response …… **+QAUDCFG: "innercodec/dlgain",<gain>** …… **OK**
Write Command **AT+QAUDCFG="innercodec/dlgain"[,<gain>]**	Response If configuration parameters are omitted (**+QAUDCFG="innercodec/dlgain"**), return the current configuration: **+QAUDCFG: "innercodec/dlgain",<gain>** **OK** If configuration parameters are entered:

	OK
	ERROR
	If error is related to ME functionality:
	+CME ERROR: <err>

Parameter

| **<gain>** | Numeric type, indicates the downlink digital gain level for internal codec. Range: 0-65535. Default value might be different in different audio modes |

NOTES

1. The parameter will not be saved.
2. This command is intended for UCxx modules only.

Example

AT+QAUDCFG="innercodec/dlgain",8000 //Set downlink digital gain to 8000.

OK

7 Appendix A References

Table 3: Related Documents

SN	Document name	Remark
[1]	Quectel_UCxx/EC2x_Hardware_Design	Hardware design for UC15, UC20, EC25, EC21, EC20 and EC20 R2.0
[2]	Quectel_UCxx/EC2x_Reference_Design	Reference design for UC15, UC20, EC25, EC21, EC20 and EC20 R2.0
[3]	Quectel_UCxx/EC2x_AT_Commands_Manual	AT commands manual for UC15, UC20, EC25, EC21, EC20 and EC20 R2.0
[4]	Quectel_WCDMA_UGxx_Audio_Design_Note	Audio design note for Quectel WCDMA UGxx modules

Table 4: Terms and Abbreviations

Abbreviation	Description
EEC	Enhanced Echo Canceller
ESD	Electrostatic Discharge
I2C	Inter Integrated Circuit
LDO	Low Dropout Regulator
LSB	Least Significant Bit
MCU	Microcontroller Unit
ME	Mobile Equipment
MSB	Most Significant Bit
NR	Noise Reducer
NV	Non-Volatile Memory
PCB	Printed Circuit Board

PCM	Pulse-code Modulation
RC	Resistance Capacitance
RF	Radio Frequency
THD	Total Harmonic Distortion
TDD	Time Division Duplexing
UART	Universal Asynchronous Receiver/Transmitter
XTAL	Crystal